# CHAPTER 5

# 5.0 EVALUATING THE HHRA OF REMEDIAL ALTERNATIVES

## 5.1 INTRODUCTION

The risk assessment methodology presented in Chapters 3 and 4 focused upon the performance of the screening risk analysis used in the PA/SI, and the BRAs as appropriate for RIs. This methodology serves as the framework for all risk assessments. As mentioned earlier, risk assessments may also be performed for other aspects of site activities.

One aspect is the performance of risk assessments to support evaluations in the FS. As part of FS activities, different remedial alternatives are examined from a number of perspectives as part of the selection process. The NCP specifies nine selection criteria to be examined as part of remedial alternative evaluation: (1) protection of human health and the environment, (2) compliance with ARARs, (3) long-term effectiveness and permanence, (4) reduction of toxicity/mobility/volume through treatment, (5) short-term effectiveness, (6) implementability, (7) cost, (8) state acceptance, and (9) community acceptance. There are three risk assessment procedures that can be applied to aid in the evaluation of remedial alternatives.

The three types of risk assessments are:

- The development of RGs to be applied to site cleanup.
- The evaluation of long-term risks associated with the alternatives.
- The evaluation of short-term risks associated with implementation of the remedy.

The first type is sometimes performed as a component of the RI, but is distinguished herein because of its use in selection of remedial options. The other two types are useful in comparative evaluation of potential remedial options. They are discussed individually below.

## 5.2 DEVELOPMENT OF RGs

RGs are media-specific chemical concentrations that are associated with acceptable levels of chemical intake. RGs, sometimes also referred to as cleanup goals or TCLs, are considered along with other factors such as ARARs in identifying the chemical concentrations to which impacted media are to be remediated. In general, RGs are developed when the chemical-specific risks and hazards exceed acceptable levels.

RGs differ from PRGs in that site-specific factors are considered. PRGs are developed as a screening level tool prior to the performance of an RI. Conversely, RGs are developed from the site-specific BRA that was developed during the RI. See RAGS Part B (USEPA, 1991d) for a complete discussion of this process.

**RGs Must be Developed and Applied in the Context of Exposure Area and the Exposure Point Concentration. It is Not Necessary to Remediate All Media to or Below the RG.**

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Risk assessments are based on the 95% UCL of the mean contaminant concentration. Calculation of an RG establishes a firm number to be used for cleanup. By requiring that all confimatory samples be below the RG, excessive cleanup is done and results in unnecessary cost escalation. A more realistic approach is to evaluate an exposure area, calculating concentrations that would result in a residual 95% UCL equal to the RG. The calculation includes the clean fill and the non- or minimally impacted areas. This calculation should be done as part of the RD, determining an adjusted RG. Additional information can be obtained from Bowers, et al. (1996).

RGs should be based upon all significant exposure pathways assessed in the BRA for that medium. However, since the pathways resulting in the highest degree of exposure will most greatly influence the RG, exposure pathways that have minimal contribution to overall risks can be excluded from the RG development with little or no impact. In general, if a given exposure pathway contributes less than 1 percent of the overall risks, it can be disregarded in RG development.

## 5.3 EVALUATION OF LONG-TERM RISKS

**5.3.1 Comparative Risk Assessment of Remedial Alternatives.** For a remedial alternative to be acceptable, it must be protective of human health and the environment. However, more than one alternative may meet this criteria. In these instances, an assessment of the long-term residual risks associated with both alternatives can be developed as a tool to assist in selecting an alternative. By comparing the degree to which an alternative reduces potential risks with other factors such as cost, acceptability, and effectiveness, one alternative may be preferable.

**5.3.2 Risk Reduction.** In addition to cost aspects, the reduction of risk offered by the alternative should be examined with respect to the risks estimated in the BRA. If the risk reduction offered is not significant, or does not address the primary risks identified in the baseline assessment, these factors should be considered in the remedy evaluation.

The reduction of risk offered by the alternative should also be examined with respect to the size of the population affected by the baseline risks or remedial alternative's reduction of risk. Although protection of all receptors is the primary goal, a modest reduction of risk for a large population may be preferable to a large reduction of risk for a small group.

**5.3.3 Residual Risk.** The potential risks to be addressed in a risk analysis of the alternatives are those remaining after the implementation and completion of the remedial alternatives. The calculational methodology for performing this type of the assessment is the same as for a BRA. The potential exposure pathways and receptors should also be the same as the BRA (unless temporal factors modify some of the pathways or receptors). The main factor that will change is the chemical concentration (i.e., exposure point concentration) to which the receptors may be exposed.

When developing an estimate of potential exposure point concentrations after remediation, careful consideration must be given to where remediation is to take place and where no action is anticipated. It is not uncommon for RAs to focus in some areas of a site, leaving others untouched. Therefore, estimating the potential exposure point concentration is not as simple as assuming exposure to the RG, but will be a combination of attaining the RG in some locations, being below the RG at others, and perhaps exceeding the RG in some isolated areas where (for some other valid reason) remediation is not anticipated. The potential risks associated with different combinations of remedial alternatives can be addressed by examining each media separately, and then combining the associated risks in modular fashion.

## 5.4 SHORT-TERM RISKS ASSOCIATED WITH REMEDIATION

Another area in which risk assessment methodology can be applied is the evaluation of short-term risks associated with the implementation of each remedial alternative. The objective of this assessment is to evaluate whether the RA poses unacceptable potential risks to workers and other nearby receptors for each alternative evaluated in the FS.

This type of risk assessment is distinct from the BRA, as additional receptors may be exposed, and concentrations of chemicals may also differ. Additional exposure pathways may also exist. Depending on the length of time in which the remedial alternative may be carried out, short- and/or longer-term risks may need to be assessed.

This assessment focuses on the potential risks associated with the implementation and operation of the alternative. Therefore, an important component is to identify the exposure pathways potentially associated with the alternative. The risk assessor should work closely with the design engineers to identify potential for the alternative to result in exposure of workers or nearby populations. Depending on the type of alternative, exposure could occur through entrainment of soil (in the case of soil excavation), volatilization (from air stripping), or other pathways.

Once the potential exposure pathways are identified, the risk assessor needs to identify the potential degree of exposure. Remedial designers may be able to provide actual emission rates for certain alternatives. In other instances, predictive modeling may need to be applied to estimate exposure point concentrations. Once exposure factors are identified, quantitation of potential risks is calculated in the same manner as other risk assessments.

If unacceptable risks are estimated for the alternative, the use of control technologies or other management options should be examined as risk reduction measures and/or evaluation of other alternatives which may have less potential to cause short-term risks. Examples of controls include use of carbon filters on air strippers, dust suppression, use of personal protection equipment, or other controls that will reduce exposures. These factors should be weighed with other FS criteria such as cost, feasibility, schedule, risk reduction, etc., in choosing the most appropriate alternatives.